

10 Hz problem: where does it come from, what can and will be done about it

10 Hz problem: where does it come from

flow of Helium in the cryogenic systems caused low frequency vibrations of the magnets
each triplet vibrated at multiple unique frequencies
influence of triplet vibrations on the beam trajectories predominantly in horizontal plane

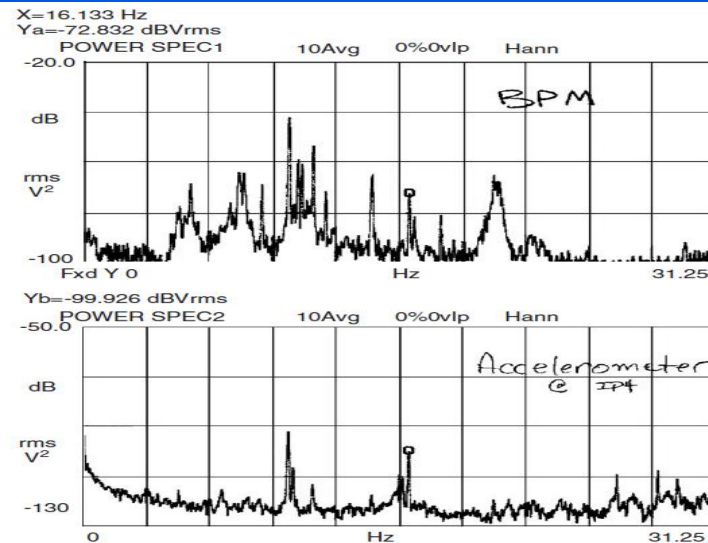
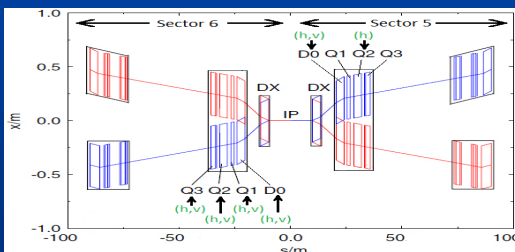
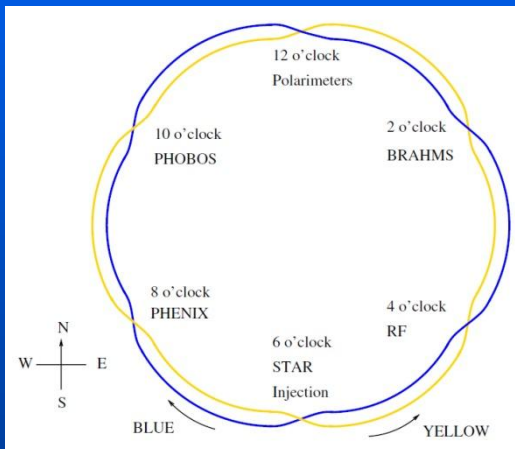
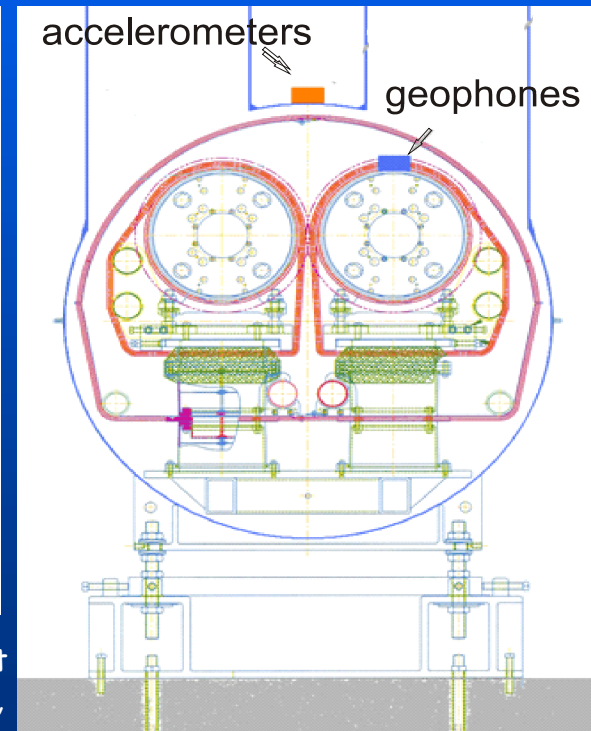


Fig. 4. Simultaneously measured spectra in RHIC, showing the beam orbit motion in the "yellow" ring (top) and acceleration from mechanical vibrations at the 4 o'clock triplet cryostat (bottom).

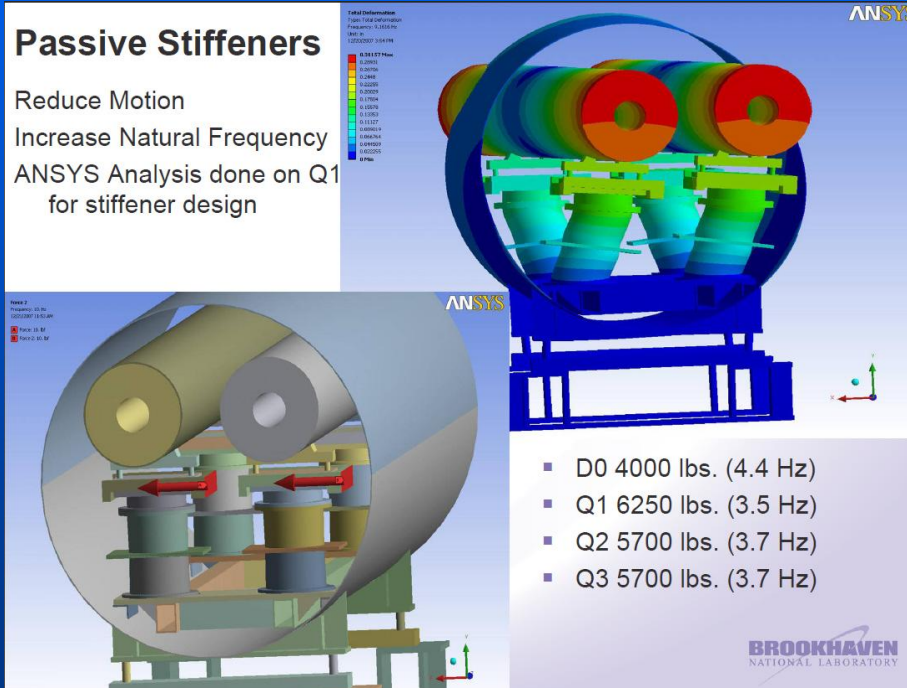
"Observation of Helium Flow Induced Beam Orbit Oscillations at RHIC", NIM A564 (2006) 26-31, C. Montag et al



10 Hz: what can be done

Past remedial actions:

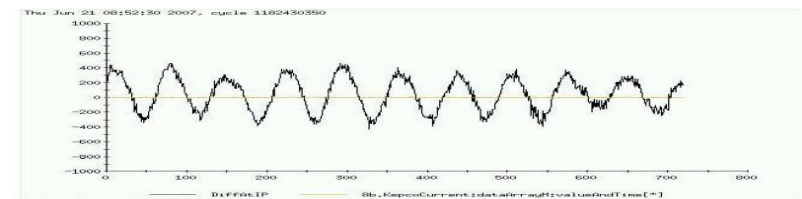
- 1) decoupling of cryogenic lines
- 2) local orbit feedback to zero relative displacement between colliding beams
- 3) passive stiffener designs



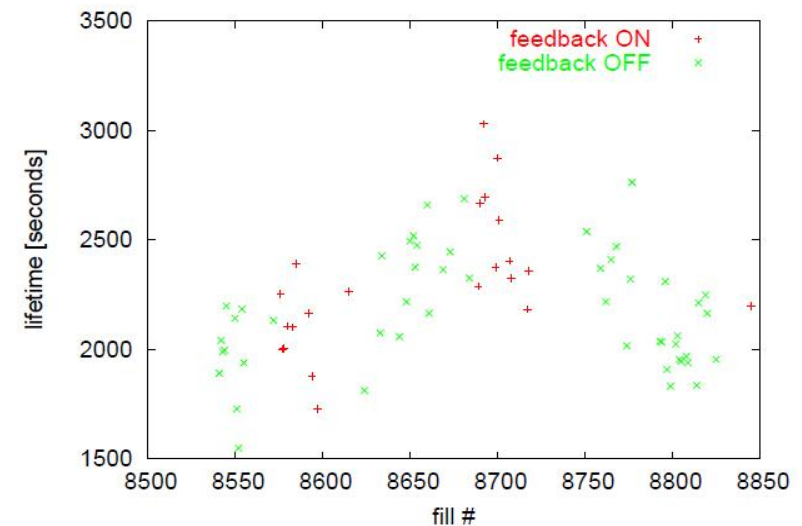
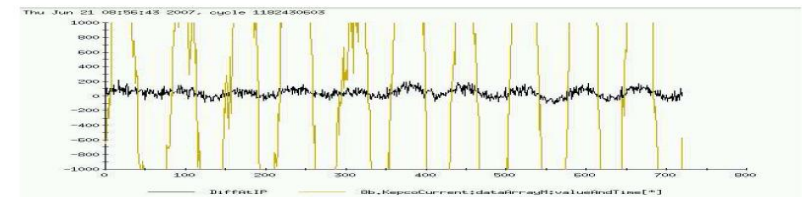
http://www.c-ad.bnl.gov/RHIC/retreat2008/talks/10_10_tuozzolo.pdf

10 Hz orbit error at IR8

Feedback OFF:

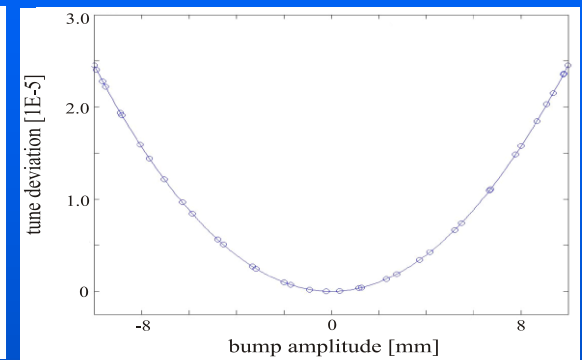
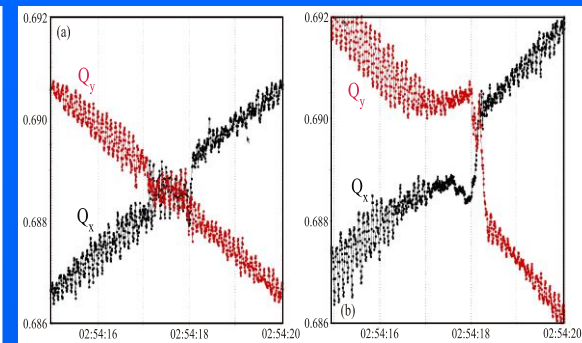
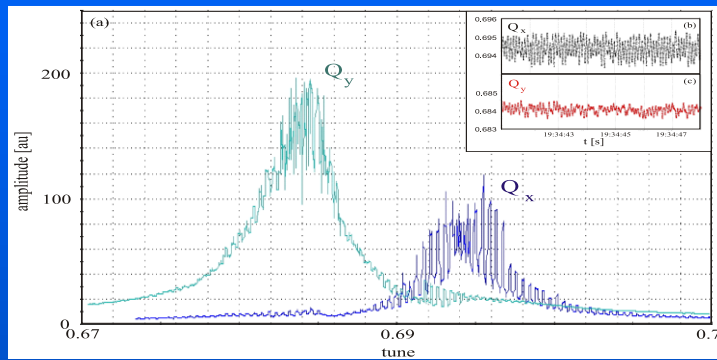
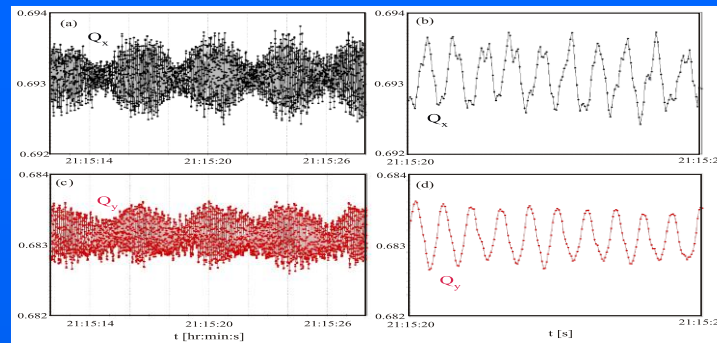
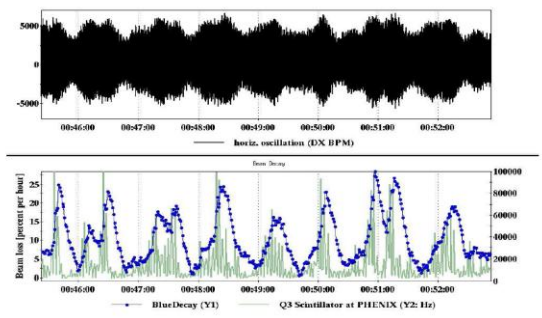


Feedback ON:

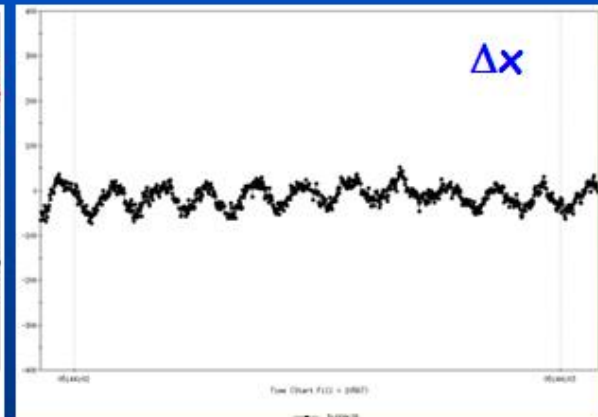
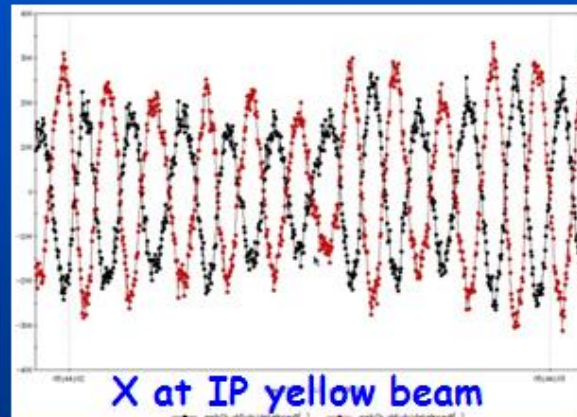
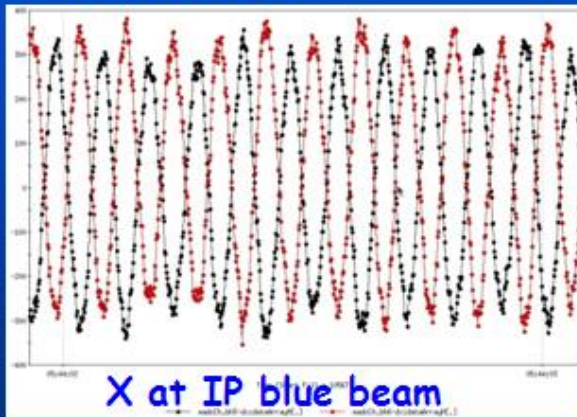


C. Montag "Run-8 Polarized Protons", RHIC Retreat

10 Hz: effect on beam



2009: IR orbits



04/16/09, fill 10567

100 GeV, p+p

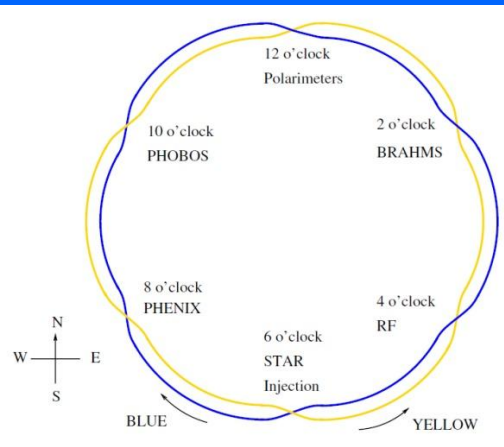


beams "tilting" with respect to one another due to 10 Hz
blue and yellow beams out of phase wrt tilt
residual CENTROID motion is small



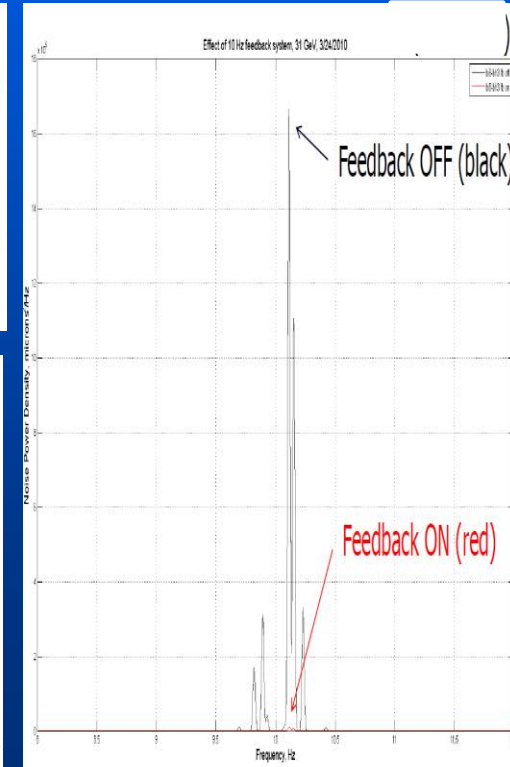
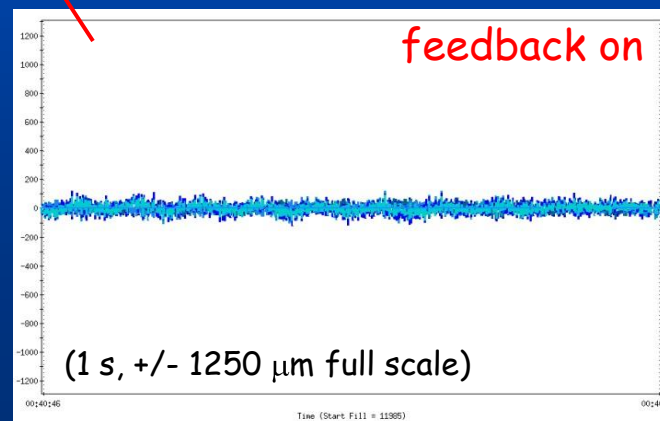
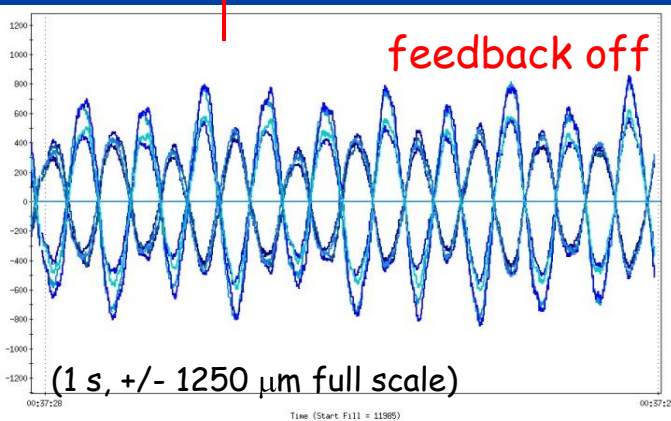
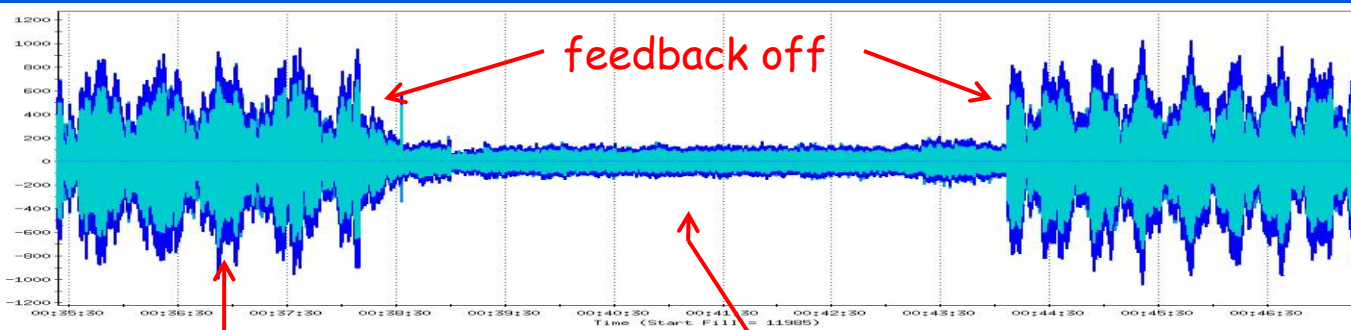
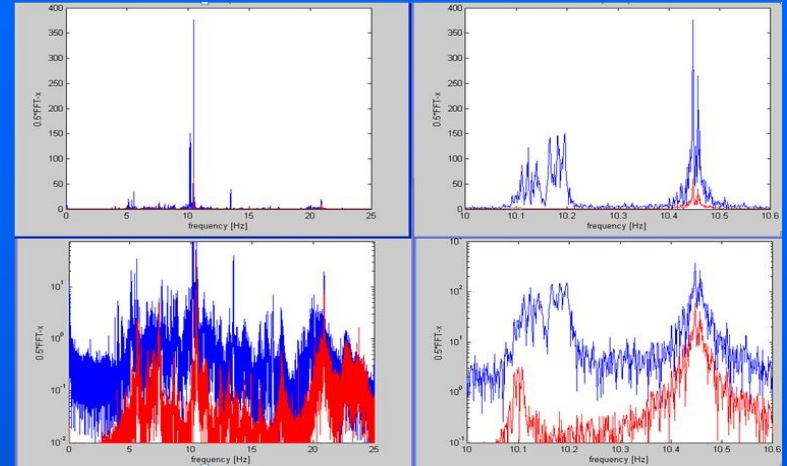
10 Hz: what will be done

V. Ptitsyn: a 12-by-12 scheme (1 BPM, 1 corrector /triplet) effectively compensates the triplet vibration



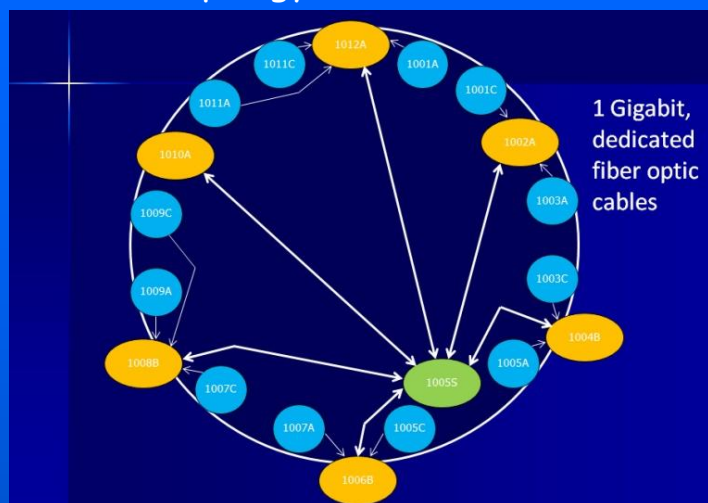
FY10 - prototype run
4 correctors
8 BPMs
(around IP6 and IP8)

FY11 - goal: full installation
12 correctors
36 BPMs

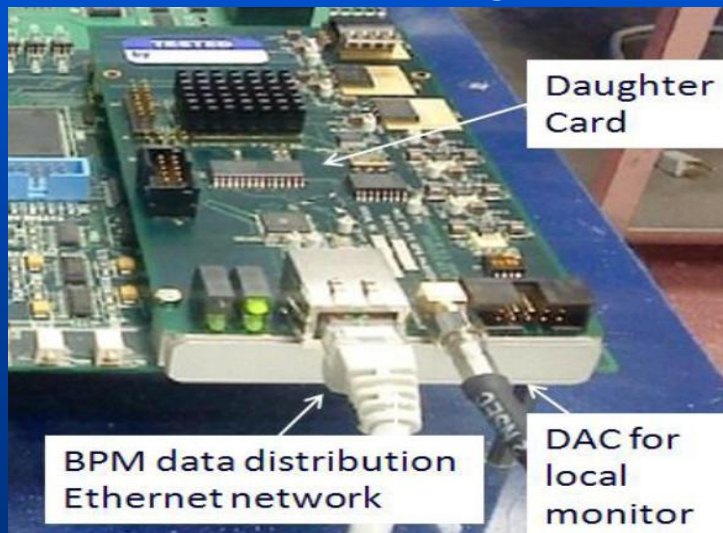


10 Hz: what will be done

network topology (~ 10 kHz data rate)



RHIC BPM IFE w/ new daughter card



Xilinx, ML-510 (Virtex-5 FPGA)



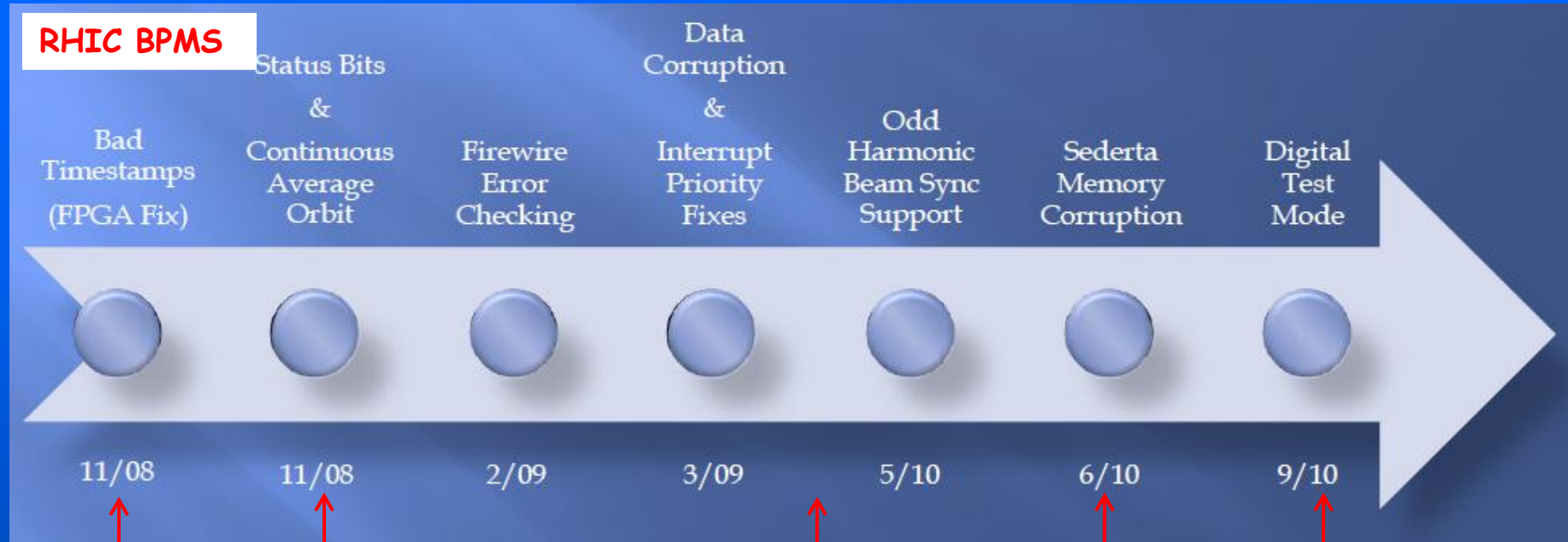
new steel laminated core magnets



R. Michnoff, P. Cerniglia, A. Curcio, C. Folz, C. Ho, R. Hulsart, W. MacKay, G. Mahler, W. Meng, K. Mernick, M. Minty, V. Ptitsyn, J. Ritter, P. Thieberger, A. Weston, P. Ziminski

Accelerator Instrumentation Including Plans for Improvements

RHIC BPMS



(due to bad DSP interrupts)
T. Satogata
R. Michnoff

R. Michnoff

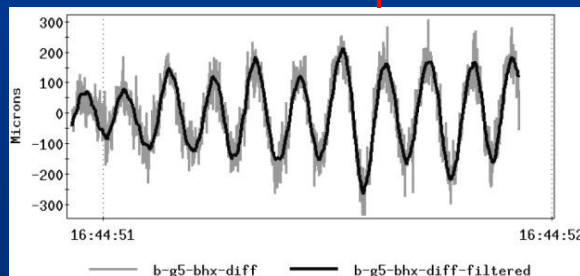
BPM offsets fixed
T. Satogata
J. Ziegler

overwrites fixed
R. Hulsart
R. Michnoff

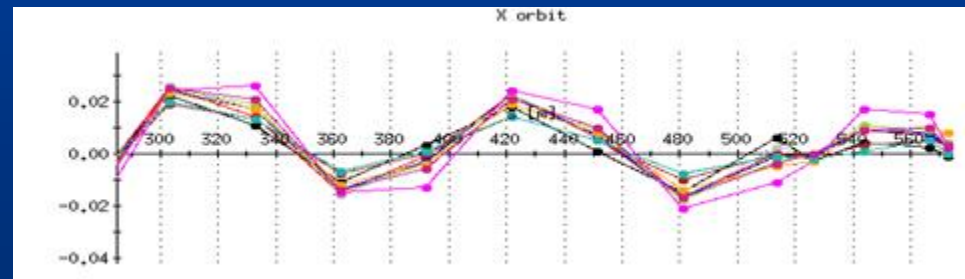
turn-by-turn

timing "slips" found and fixed

R. Hulsart
R. Michnoff
A. Marusic



"average"
orbit

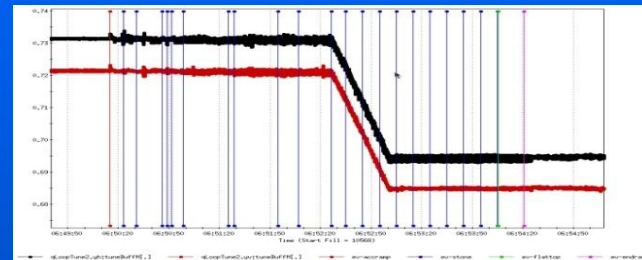
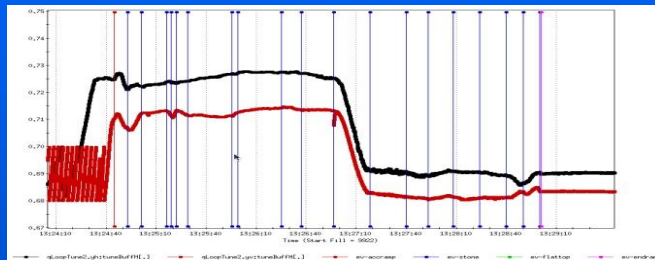
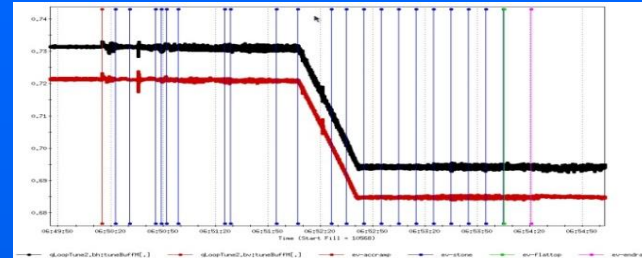
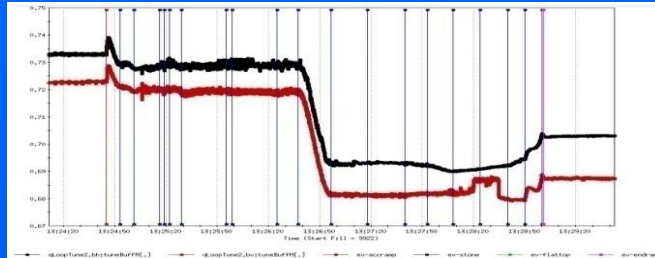


RHIC tune and coupling feedback

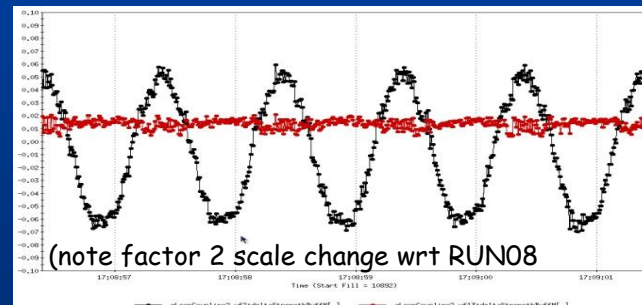
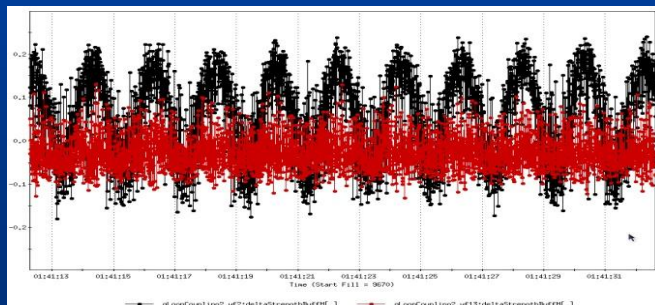
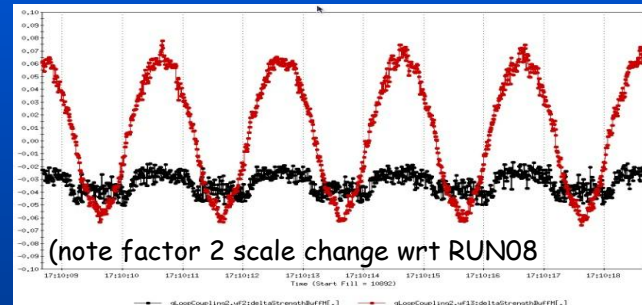
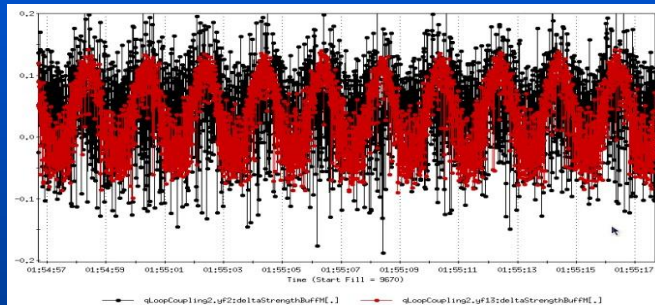
run08

run09

tunes



coupling

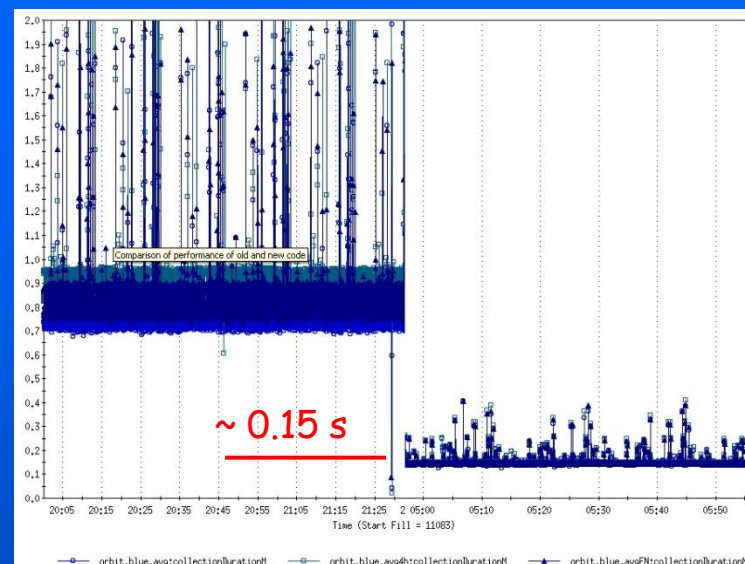
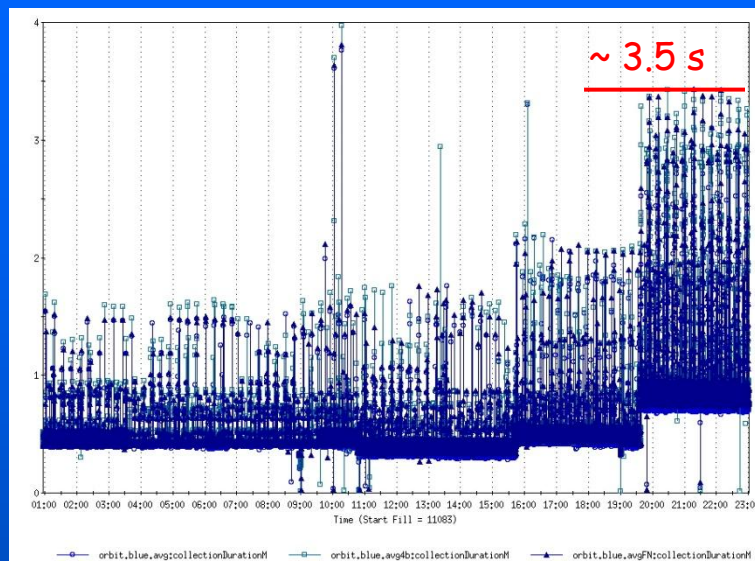


RHIC orbit feedback

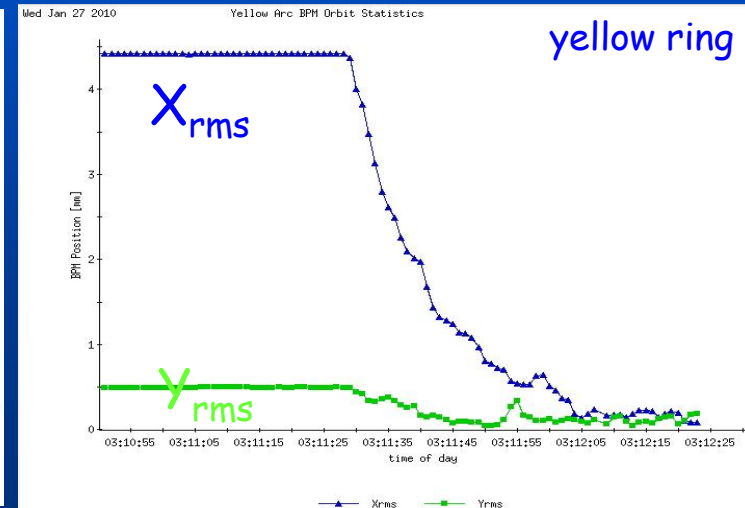
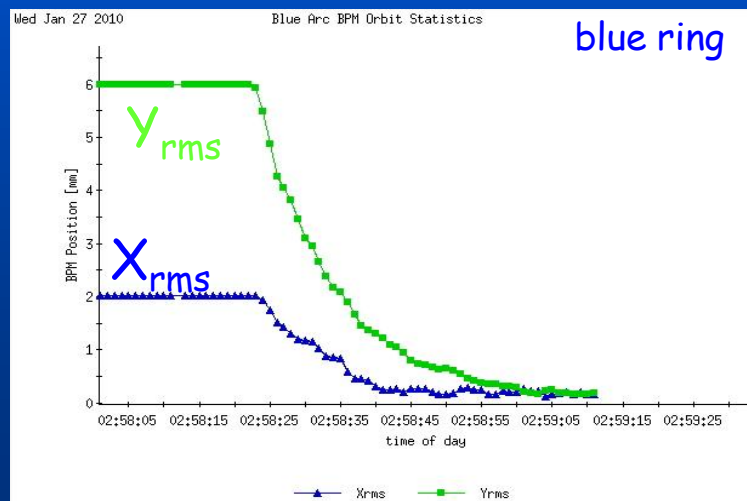
uses ~ 150 beam position measurements and ~120 correctors in each plane:
horizontal (x) and vertical (y) in the blue and yellow rings

+ conversion to "BPM-based" orbit references

improved (deterministic) BPM data delivery (network code mods)

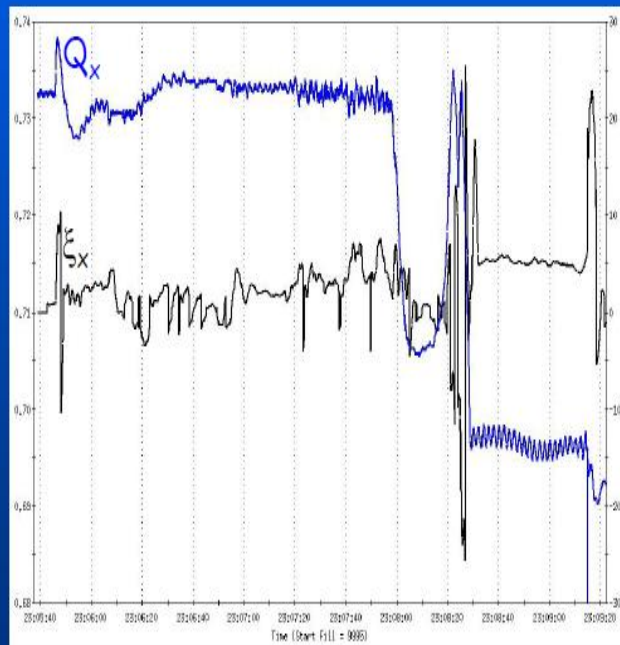


convergence tests

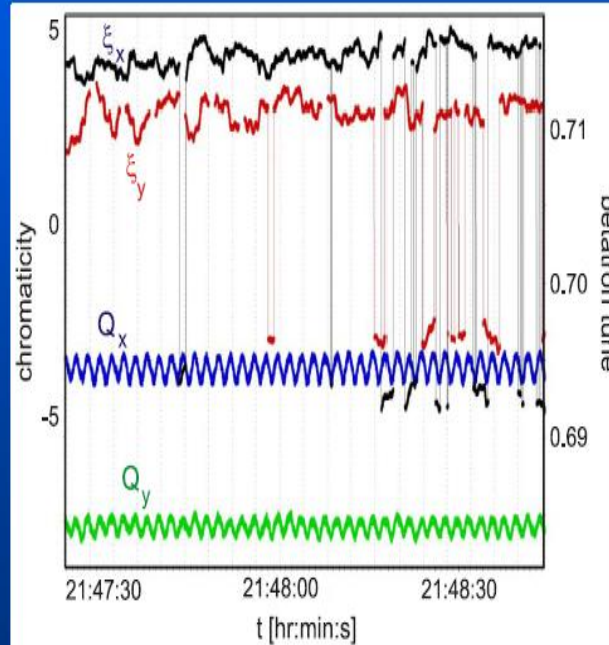


RHIC chromaticity feedback

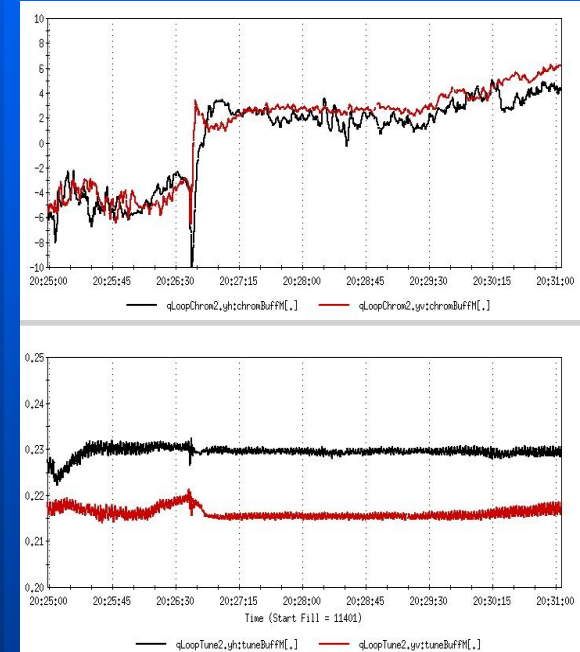
run08



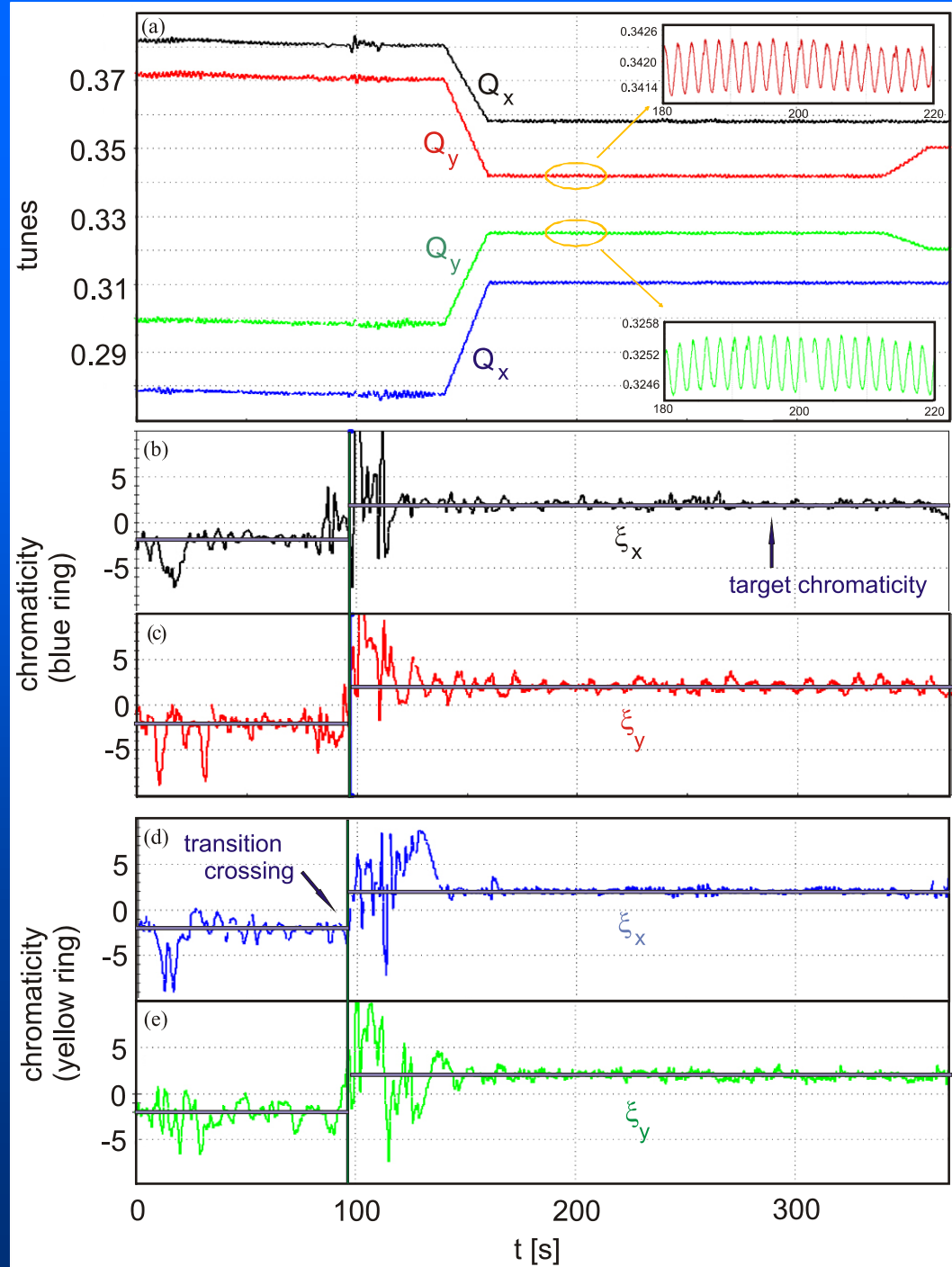
run09



run10



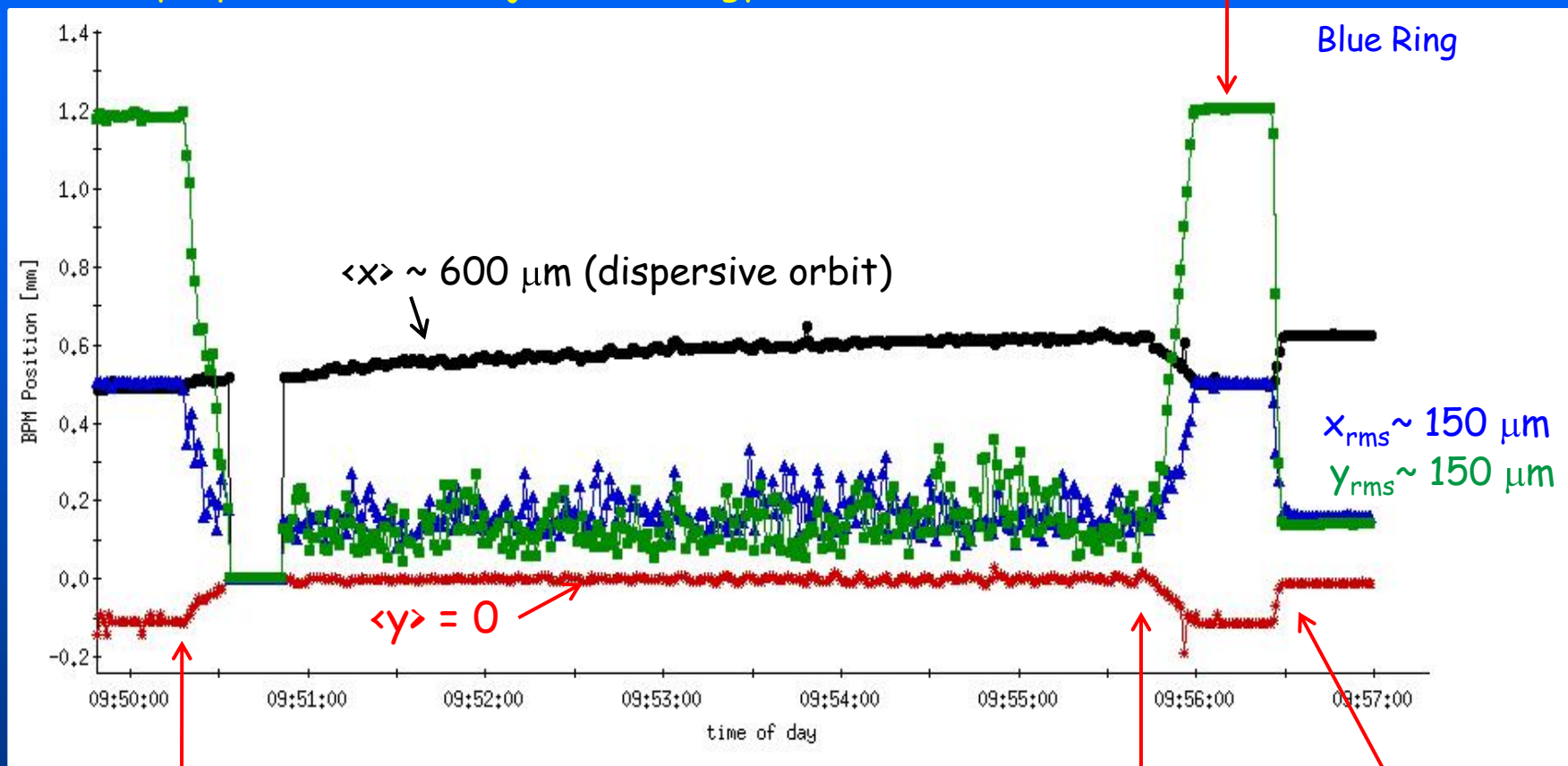
RHIC tune, coupling, and chromaticity feedback



RHIC simultaneous orbit, tune+coupling, and chromaticity feedback

04/08/10 - 39 GeV, Au107

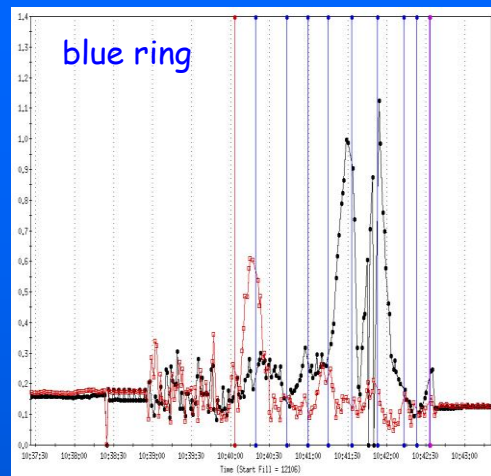
09:50 - prepare orbits at injection energy



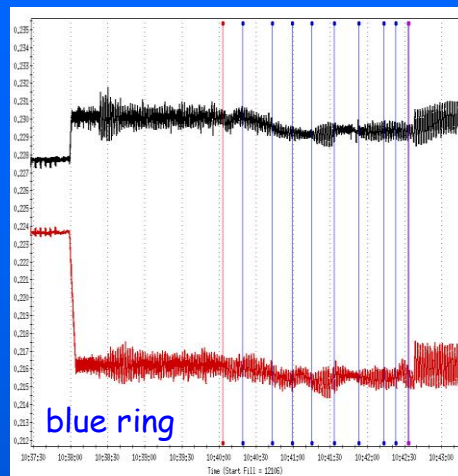
10:40 - 1st ramp of both beams to store energy with all feedbacks

11:46 - 2nd ramp

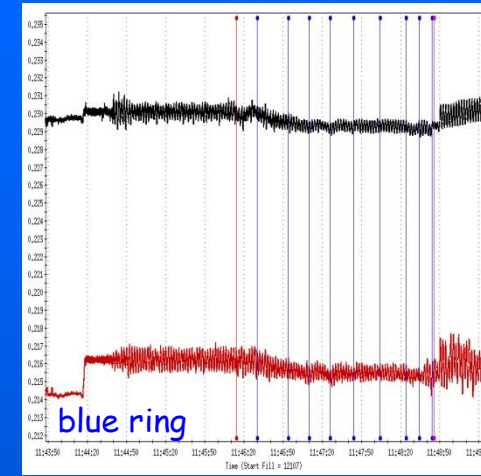
ORBITS



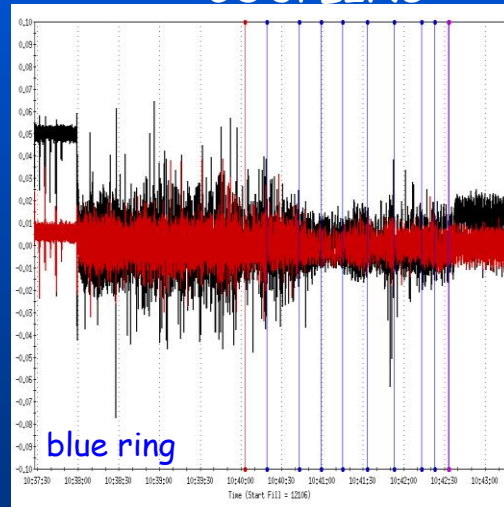
TUNES



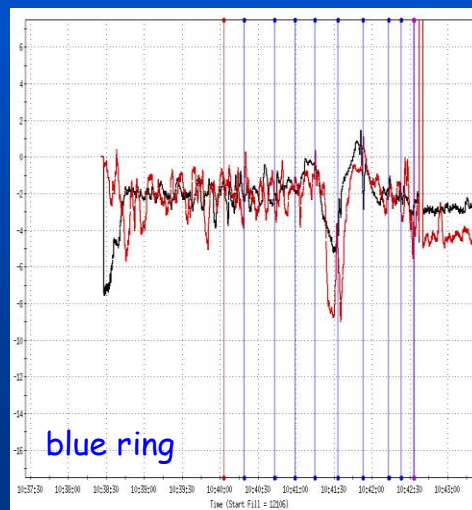
TUNES



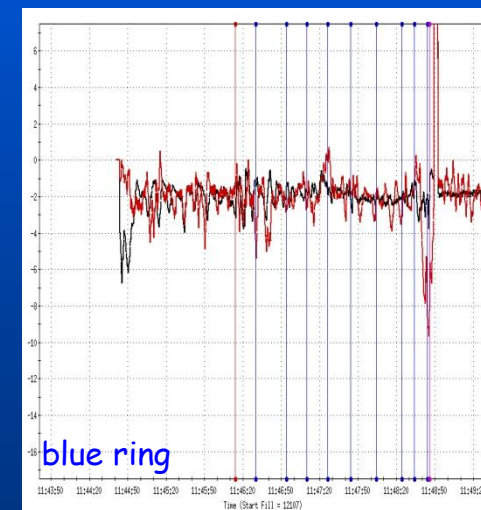
COUPLING



CHROMATICITY



CHROMATICITY



ramp efficiencies:

33% blue (6 bunches)

99% yellow (6 bunches)

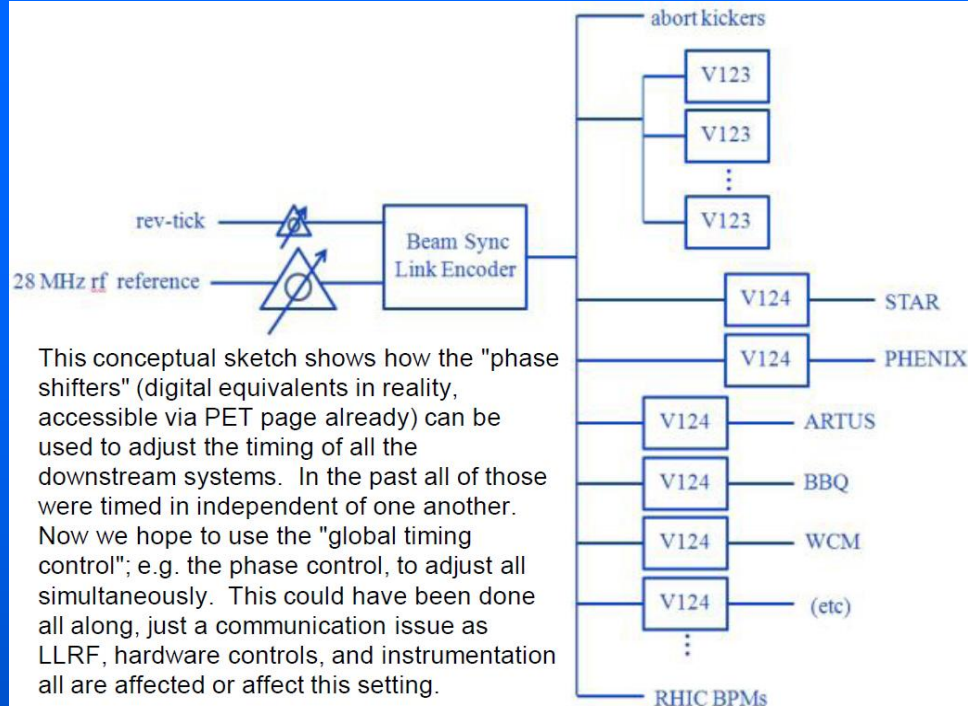
ramp efficiencies:

98% blue (6 bunches)

98% yellow (6 bunches)

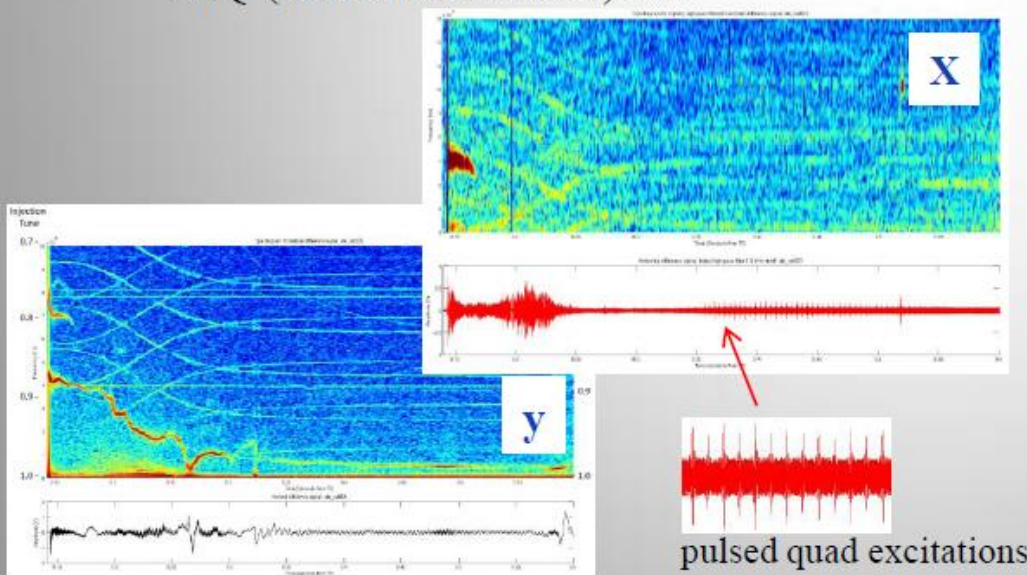
- **New Installations**
 - RHIC Stochastic Cooling
 - RHIC Spin Flipper
 - RHIC and AGS Polarimetry
 - RHIC 10 Hz Global Orbit Feedback
 - EBIS
 - HEBT LPM
 - pEDM
 - Drell -Yan
- **New Developments**
 - RHIC Orbit, Tune, Coupling, and Chromaticity Feedback
 - RHIC Deterministic Timing Configurations
 - AGS BBQ
 - RHIC Spin Flipper Diagnostics
 - RHIC WCM and DCCT Modifications
- **Improvements to Existing Systems**

new developments: deterministic timing
(A. Marusic)



new developments: AGS BBQ (K. Mernick)

RUN-10: Pre-prototype using modified RHIC
BBQ (direct-diode detection) AFE



RUN-11: New electronics at G3PUE

Parasitically measure tune without a kicker.
Help avoid polarized proton resonances.

